

What is claimed is:

1. A structure for providing optically resonant modes, comprising:
 - 5 a.) a cavity structure providing a surface of revolution;
 - b.) a multilayer dielectric reflector deposited on the surface of revolution, the reflector defining an optically resonant cavity with resonant modes, the reflector substantially delimiting propagation within the cavity to preferred resonant modes;
 - 10 c.) an optical gain medium within the optical cavity, the medium disposed for emitting optical radiation into the preferred modes.
2. The structure of Claim 1, wherein the medium is pumped by a discharge.
- 15 3. The structure of Claim 1, wherein additional layers are deposited for additional functions.
4. The structure of Claim 1, wherein the multilayer dielectric reflector contains more than 60 layer pairs, the pairs having a refractive index difference, $n_H - n_L$
20 < 0.2 .
5. The structure of Claim 1, wherein a material with an optical absorption cut-off limits unwanted propagation in the structure.

6. The structure of Claim 1, wherein the structure also defines a central process space in a central region of the cavity.
- 5 7. The structure of Claim 1, wherein a substantially conical reflector is used to reflect the radiation.
8. The structure of Claim 1, wherein the radiation is used for materials processing.
- 10 9. The structure of Claim 1, wherein the radiation is used for the treatment of optical fiber.
- 15 10. The structure of Claim 1, wherein the radiation is used for the treatment of optical fiber preforms.
11. The structure of Claim 1, wherein the radiation is used for the treatment of semiconductor processing gases.
- 20 12. The structure of Claim 1, wherein the gain medium is a gas.
13. The structure of Claim 1, wherein the gain medium is solid state.
14. The structure of Claim 1, wherein the surface of revolution is discontinuous.

15. The structure of Claim 1, wherein the reflector is discontinuous.
16. The structure of Claim 1, wherein the gain medium provides a narrow
5 fluorescence spectrum.
17. The structure of Claim 1, wherein radiation is coupled through the surface of revolution.
- 10 18. A structure for providing optically resonant modes, comprising:
a.) a cavity structure providing a spherical surface of revolution;
b.) a multilayer dielectric reflector deposited on the surface, the reflector defining an optically resonant cavity with resonant modes, the reflector having an angle-dependence, so that mode propagation within the cavity is substantially limited to preferred resonant modes; and,
c.) a gain medium within the cavity, the medium disposed for emitting optical radiation into the preferred modes.
- 15 19. The structure of Claim 18, wherein the cavity comprises a solid, the solid transmitting a desired optical spectrum.
- 20 20. The structure of Claim 18, wherein the gain medium is a gas.

21. A structure providing optically resonant modes, comprising:

- a.) a cavity structure providing opposing optically reflecting surfaces, the opposing surfaces defining a cavity;
- 5 b.) a multilayer dielectric reflector deposited on at least one opposing surface, the reflector composed of at least one hundred-twenty (120) alternating layers of high index n_H and low index n_L , wherein n_H and n_L are real refractive indices, wherein $n_H - n_L < 0.1$;
- c.) an optical gain medium substantially within the optical cavity, the medium disposed for emitting radiation, a solid angle of propagation for the radiation being delimited by the reflector.

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